

Cardiovascular Risk Profiles in Firefighters

Department of Kinesiology, University of Wisconsin-Eau Claire, Eau Claire, Wisconsin

Brittany Frederick, Courtney Lehman, and Sarah Suchla

Faculty Advisor: Gary P. Van Guilder, PhD



ABSTRACT

PURPOSE: Cardiovascular disease contributes to 45% of on-duty firefighter fatalities and is the leading cause of on-duty firefighter deaths. Moreover, most cardiovascular events occur in firefighters who are stratified to a high cardiovascular risk profile. Thus, it may be unsafe for some at-risk firefighters to participate in strenuous emergency duties while on-duty. Accordingly, the purpose of this study is to determine whether certain tasks specific to firefighting cause cardiovascular stress and thus increase the risk of cardiovascular events. A secondary aim was to stratify firefighters and student firefighters to low, moderate, and high cardiovascular disease risk. **METHODS:** Seventeen men (12 current volunteer firefighters, 5 firefighter students) were recruited from various career fire departments across Wisconsin to complete a series of health and fitness assessments and three selected Candidate Physical Ability Test (CPAT) maneuvers. Initially, subjects completed a series of basic health assessments to identify cardiovascular disease risk factors and to stratify them into low, moderate, or high cardiovascular risk per American College of Sports Medicine risk stratification guidelines. Subsequently, subjects stratified to low or moderate risk completed three CPAT maneuvers (3 minute stair climb, 70 foot victim drag, and breach and pull) in consecutive order as quickly as possible. Heart rate was recorded before, during and after each test to document exercise intensity. **>RESULTS:** 92% of the volunteer firefighters were identified as having a moderate to high risk for an adverse cardiovascular event. Moreover, of the 34 total CVD risk factors, 31 were observed in the volunteer firefighters. The average heart rate response for the three CPAT maneuvers was 84% of predicted maximum heart rate. Heart rate intensity significantly increased during the stair climbing test (warm-up: 136±15 bpm; minute 3: 182±14 bpm), with an average heart rate intensity of ~95% maximum at minute 3. Similarly, heart rate responses to the victim drag and breach and pull tests approached 90-95% maximum. **CONCLUSIONS:** This study found that a high number of volunteer firefighters have CVD risk factors and are at moderate to high risk of experiencing a cardiovascular event. During each CPAT maneuver, heart rate responses approached 90% of predicted maximum heart rate, which indicates it may be unsafe for firefighters who are at moderate to high risk to perform these specific on-duty tasks.

Key Words: CARDIOVASCULAR DISEASE, CANDIDATE PHYSICAL ABILITY TEST, HEART RATE, STAIR CLIMB, VICTIM DRAG, BREACH/PULL

BACKGROUND

➤It is estimated that one in three American adults has some form of cardiovascular disease, the leading cause of death in the United States.

➤Cardiovascular disease accounts for 45% of all on-duty firefighter deaths and is the number one cause of death among firefighters.

➤Previous research has shown that the rate of obesity among firefighters exceeds that of the general US population.

➤ Abnormal secretions of cortisol and a hyperactive sympathetic system caused by stress may lead to stress-induced visceral obesity and signs of metabolic syndrome. This may ultimately result in atherosclerosis and the development of CVD.

➤Studies also support a connection between occupational stress and eventual CVD, with strongest evidence focusing on hypertension.

➤Candidate Physical Ability Test (CPAT) measures the capabilities of firefighting recruits while running through a series of eight job-specific maneuvers continuously. Maneuvers include stair climb, hose drag, equipment, carry, ladder raise, victim drag, search and rescue, forcible entry, and the ceiling breach and pull.

EXPERIMENTAL AIM

To determine whether certain tasks specific to firefighting cause cardiovascular stress and thus increase the risk of cardiovascular events. A secondary aim was to stratify firefighters and student firefighters to low, moderate, and high cardiovascular disease risk.

METHODS

Subjects

- Seventeen adult male firefighters and students between the ages of 19-53 years completed a basic cardiovascular risk assessment and if selected, participated in the three chosen maneuvers of the CPAT.
- Participants were recruited using flyers, emails, and personal contact from various volunteer and career fire departments across Wisconsin.
- All subjects provided written informed consent according to the guidelines of the University of Wisconsin – Eau Claire.



Baseline Testing and Instrumentation

- Student, volunteer, or career firefighter status along with years of service was recorded.
- Health history questionnaire was completed by each participant.
- Age, auscultatory resting systolic and diastolic blood pressure, and muscular strength was recorded.
- Body composition, including height, weight, waist and hip circumference, body mass index (BMI), and percent body fat using hydrostatic weighing were assessed.

- ACSM criteria was used to stratify cardiovascular disease risk

CPAT Exercise Testing

- Eleven of the 17 subjects participated in the stair climb, victim drag, and breach/pull maneuvers of the CPAT:
 1. Stair climb consisted of a 20 second warm up period at a rate of 50 steps per minute, then was increased to 60 steps per minute for an additional three minutes
 2. Victim drag consisted of dragging a 165 pound manikin for 70 feet. The course was set up to drag the manikin down 35 feet, around a barrel, and back another 35 feet across the finish line.
 3. Breach/pull consisted of three breaches followed by five pulls for a total of four sets of each. The apparatus held 25 pounds on the breach rack and 20 pounds on the pull rack.
- Heart rate response was recorded before, during, and after each maneuver to assess percent heart rate maximum.
- A 5 minute cool down was implemented to ensure heart rate returned to 100 bpm or less.

STATISTICAL ANALYSIS

The primary dependent variables are cardiovascular risk stratification, number of risk factors, and heart rate responses to the CPAT tests. The independent variables were the CPATs. Subject demographic data were determined by descriptive analyses. The heart rate responses to the CPATs were determined using a Paired T test and Repeated Measures Analysis of Variance. Data are presented as mean±SD. Statistical significance was set at $P<0.05$. Statistical analyses were performed using SPSS software version 17.0 (SPSS Inc).

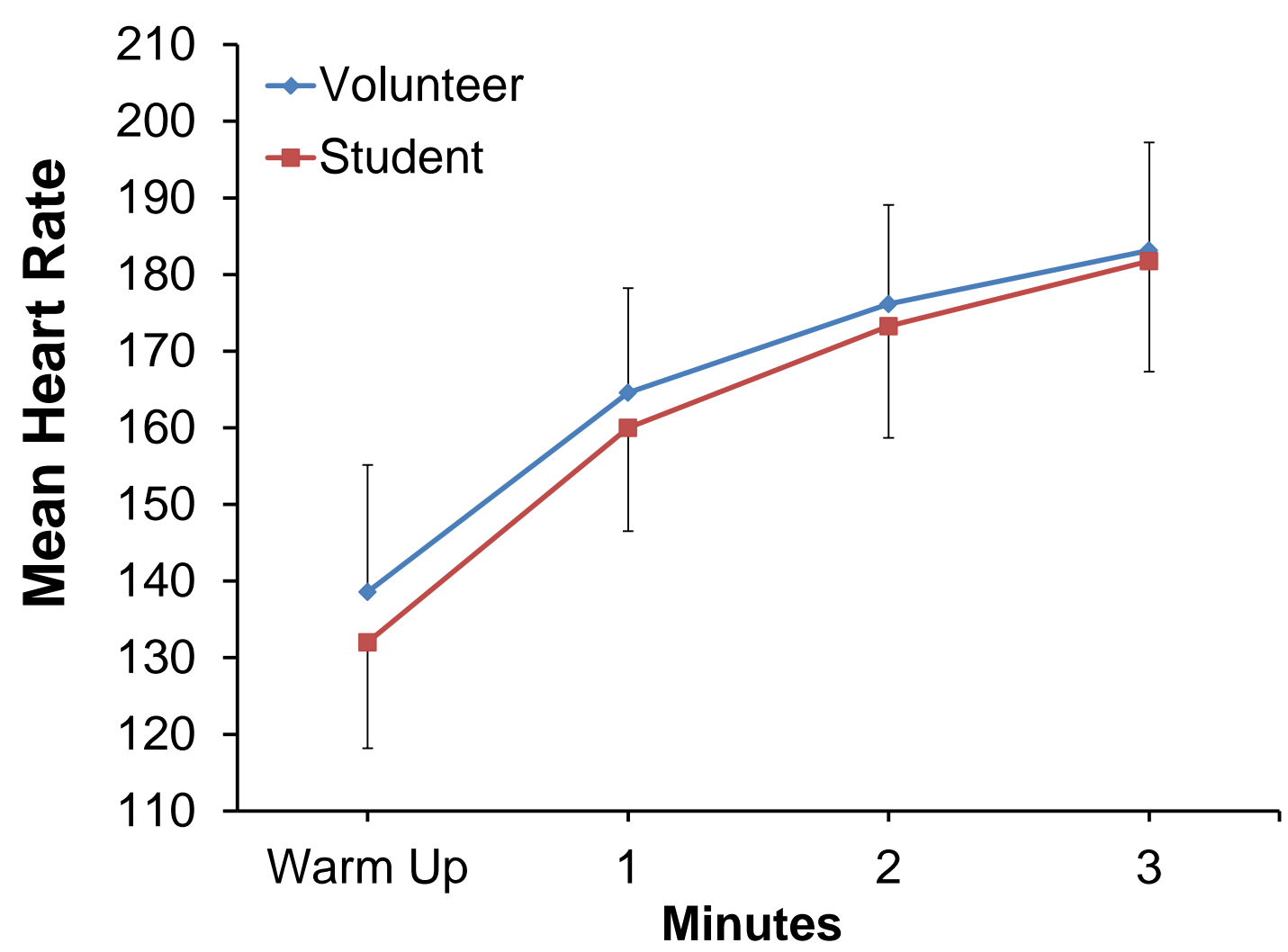
RESULTS

I. Subject Characteristics of Firefighters and Students

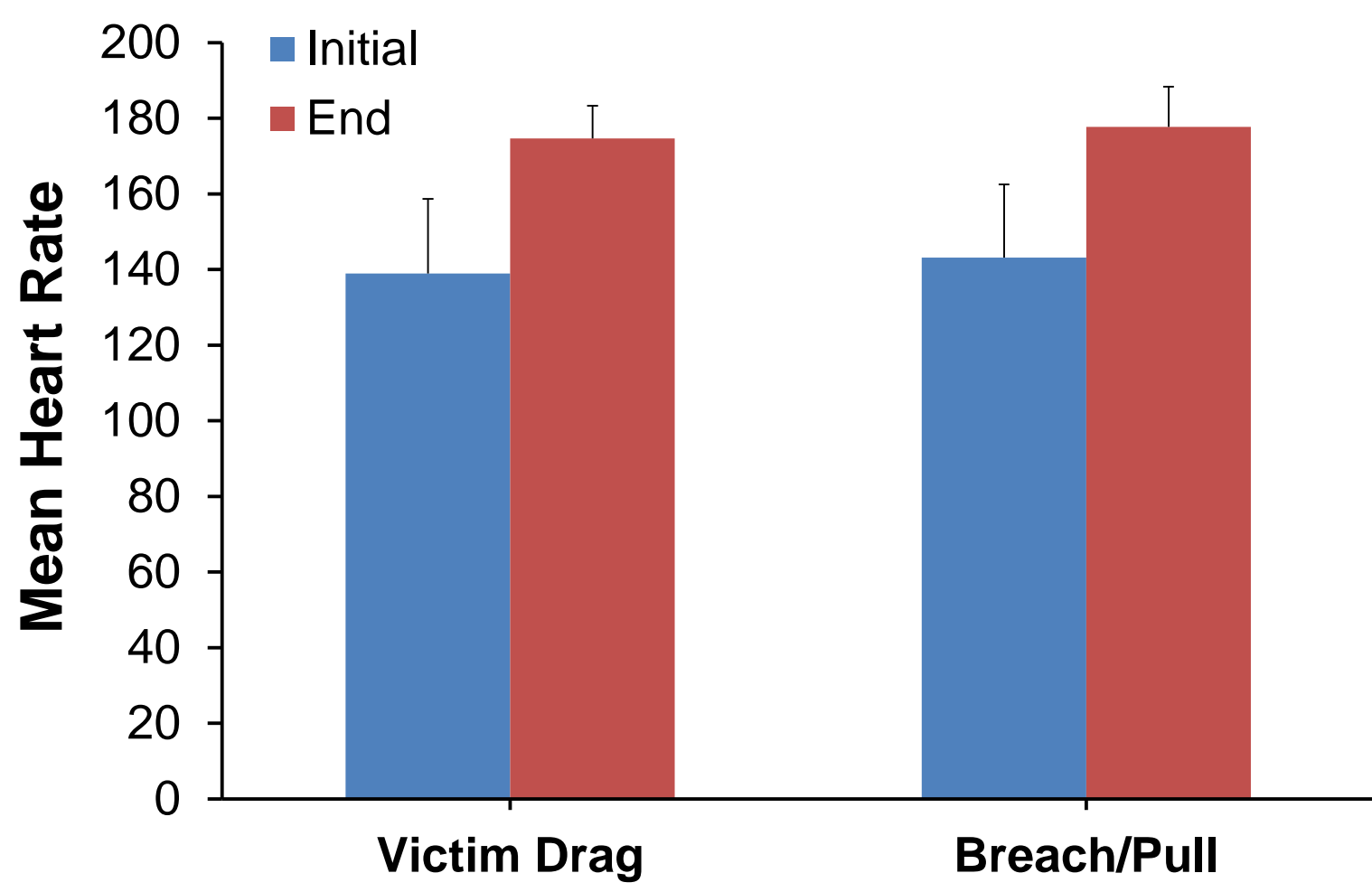
Variable	Total Group (N=17)	Volunteer FF (n=12)	Student (n=5)
Age (yrs)	28.8±11.2	31.4±12.3	22.4±3.5
Weight (kg)	96.4±18.1	100.7±17.5	86.0±16.6
Height (cm)	180.4±5.7	180.5±6.1	180.1±5.1
BMI (kg/m ²)	29.6±5.0	30.9±4.8	26.3±4.0
Systolic BP (mmHg)	128±11	128±11	128±11
Diastolic BP (mmHg)	77±9	77±9	78±11
Resting HR (bpm)	71±11	75±9	62±11
Push-ups	35±19	30±17	47±21
Waist/Hip Ratio	.90±.07	.92±.06	.84±.04
Percent Body Fat	23.3±8.6	26.0±7.7	17.2±8.1
Predicted HR Max (bpm)	188±8	186±8	192±2
Total CVD risk factors	34	31	3
Percent moderate-high risk	88	92	0
Average HR (bpm)	161±11	160±12	164±11
Average HR Percent	84.4±4.7	83.9±4.8	85.2±5.2

II. Mean heart rate response to CPAT maneuvers (A) Stair climb event (B) victim drag and breach/pull. Heart rate responses . *P < 0.05 vs. Continuous.

A.

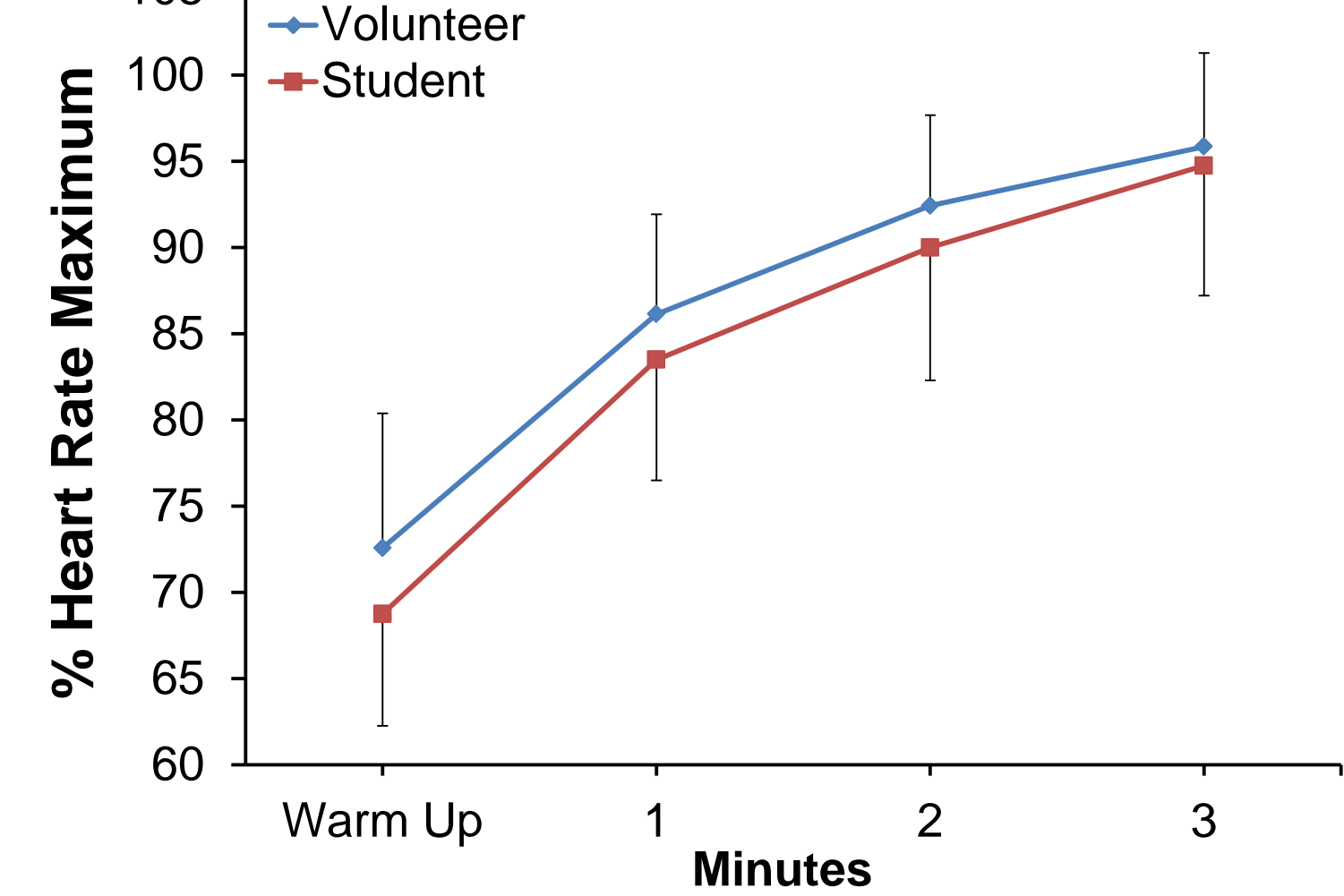


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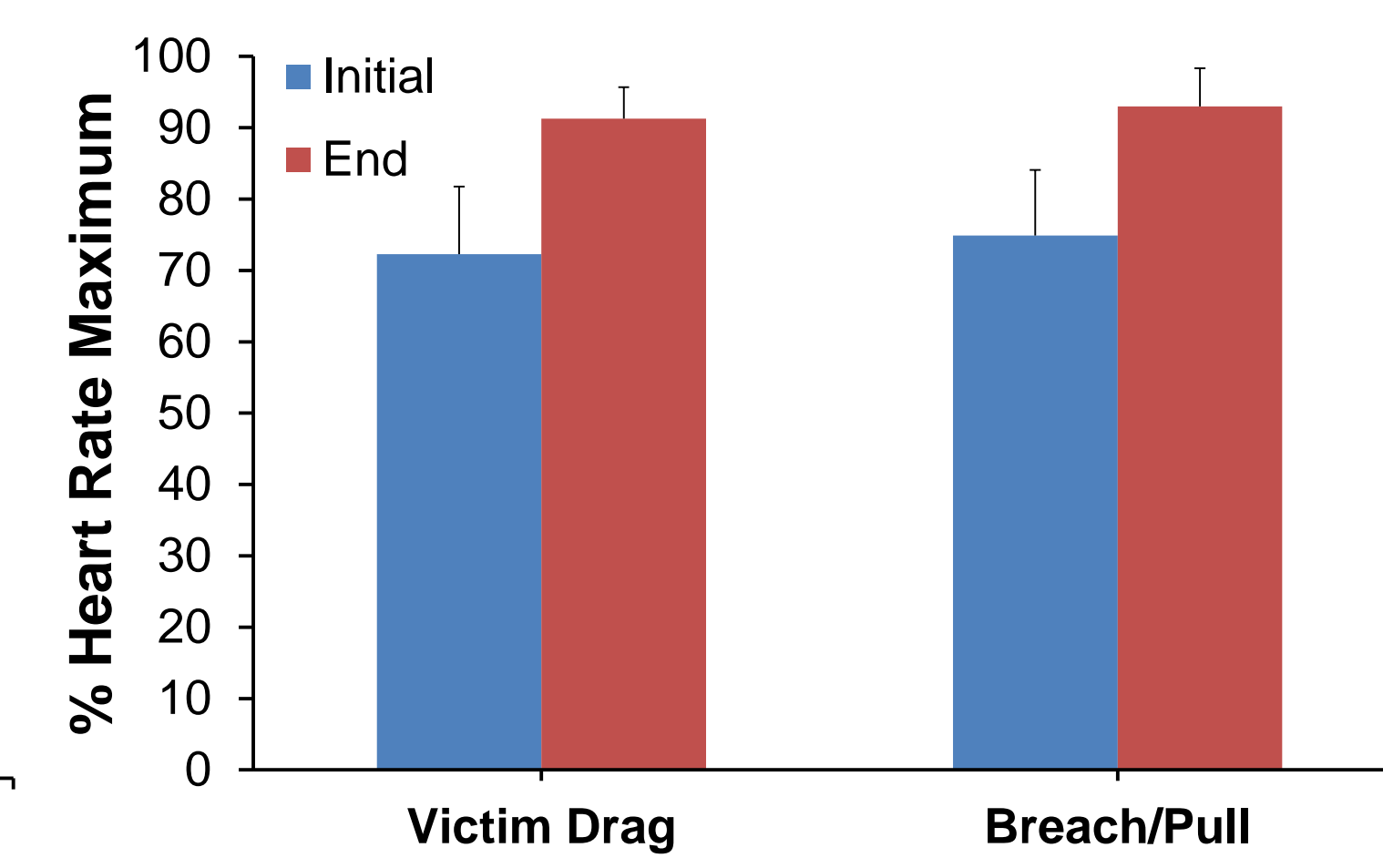


III. Percent heart rate response to CPAT maneuvers (A) Stair climb event (B) victim drag and breach/pull. Heart rate responses . *P < 0.05 vs. Continuous.

A.



B.



SUMMARY AND CONCLUSIONS

- The study found that a high number of volunteer firefighters have CVD risk factors and are at moderate to high risk of experiencing a cardiovascular event. During each CPAT maneuver, heart rate responses approached 90% of predicted maximum heart rate. Given these high heart rate intensities, it may be unsafe for firefighters who are at moderate to high risk to perform these specific on-duty tasks.
- These findings bring awareness to the firefighting community about their CVD risk and the impact it could have on their career.
- These results could be used in application toward recommending more consistent health and fitness evaluations for firefighters.

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